

What is claimed is:

1. A method of making an ester comprising:
 - (a) contacting an olefin or ether with carbon monoxide and an acid composition comprising $\text{BF}_3\cdot2\text{ROH}$ to form a product composition;
 - 5 (b) adding ROH to the product composition of (a); and
 - (c) separating an acid product comprising $\text{BF}_3\cdot2\text{ROH}$ from the ester.
2. The method of claim 1 further comprising:
 - 10 (d) recycling a portion of the separated acid product to contact the olefin or ether.
3. The method of claim 1 wherein the olefin is selected from the group consisting of ethylene, propylene, isoolefins, normal butenes, and C_5 to C_{18} olefins.
 - 15 4. The method of claim 2 wherein the olefin is isobutene.
 5. The method of claim 1 wherein the ether is represented by the general formula $\text{R}'-\text{O}-\text{R}''$, wherein R' = saturated C_1 - C_{13} alkyl and R'' = saturated C_1 - C_{13} alkyl, and R' and R'' can be the same or different.
 - 20 6. The method of claim 5 wherein the ether is methyl-t-butylether.
 7. The method of claim 1 wherein contacting the olefin or ether comprises contacting at a temperature from about 60°C to about 200°C .
 - 25 8. The method of claim 7 wherein contacting the olefin or ether comprises contacting at a temperature from about 110°C to about 160°C .
 - 30 9. The method of claim 1 wherein contacting the olefin or ether comprises contacting at a pressure from about 30 atm to about 200 atm.
 10. The method of claim 9 wherein contacting the olefin or ether comprises contacting at a pressure from about 110 atm to about 160 atm.

11. The method of claim 1 wherein ROH is an alcohol selected from the group consisting of methanol, n-propanol, n-butanol, 2-propanol, 2-ethyl hexanol, isoheanol, isoheptanol, isoctanol, isononanol, 3,5,5-trimethyl hexanol, isodecanol,
5 isotridecanol,
1-octanol, 1-decanol, 1-dodecanol, and 1-tetradecanol.

12. The method of claim 1 wherein ROH is methanol.

10 13. The method of claim 1 wherein the ether is methyl-t-butyl ether.

14. The method of claim 1 wherein the ether is diisopropyl ether and ROH
is 2-propanol.

15 15. The method of claim 1 further comprising:

(d) contacting the olefin or ether with a hydrocarbon, wherein the
hydrocarbon is selected from a saturated linear or branched hydrocarbon having at
least six carbons.

20 16. The method of claim 1 further comprising:

(d) adding a hydrocarbon to the product composition of (a), wherein the
hydrocarbon is selected from a saturated linear or branched hydrocarbon having at
least six carbons.

25 17. The method of claim 16 further comprising:

(e) separating the hydrocarbon and ROH from $\text{BF}_3 \cdot 2\text{ROH}$ and directing a
portion of the separated hydrocarbon and the separated ROH to a unit selected from
the group consisting of a separation unit, a reaction unit, and a combination thereof.

30 18. The method of claim 1 further comprising:

(d) contacting the olefin or ether with phosphoric acid.

19. The method of claim 1 wherein separating the acid product comprises concentrating the acid product such that the molar ratio ROH:BF₃ in the concentrated acid product is from about 2:1 to about 4:1.

5 20. The method of claim 19 wherein the concentrated acid product comprises a molar ratio of ROH:BF₃ from about 2:1 to about 3:1.

21. The method of claim 1 wherein the acid composition comprises a molar ratio of ROH:BF₃ from about 1.6:1 to about 3: 1.

10 22. The method of claim 21 wherein the acid composition comprises a molar ratio of ROH:BF₃ from about 1.9:1 to about 3: 1.

15 23. The method of claim 1 where the product composition contains less than 3% by weight carboxylic acid.

24. A method of making methyl pivalate comprising:
contacting methyl-t-butylether with carbon monoxide and an acid composition comprising BF₃·2CH₃OH to form a product composition comprising methyl pivalate;
20 adding methanol to the product composition; and
separating an acid product comprising BF₃·2CH₃OH from the methyl pivalate.

25 25. The method of claim 24 wherein contacting methyl-t-butylether comprises contacting at a temperature of about 110°C to about 160°C.

26. The method of claim 24 wherein contacting methyl-t-butylether comprises contacting at a pressure from about 30 atm to about 200 atm.

27. The method of claim 24 further comprising contacting the
30 methyl-t-butylether with a hydrocarbon, wherein the hydrocarbon is selected from a saturated linear or branched hydrocarbon having at least six carbons.

28. The method of claim 24 further comprising contacting the product composition with a hydrocarbon, wherein the hydrocarbon is selected from a saturated linear or branched hydrocarbon having at least six carbons.

5 29. The method of claim 28 further comprising separating the hydrocarbon and the methanol from the methyl pivalate and directing a portion of the separated hydrocarbon and the separated methanol to a unit selected from the group consisting of a separation unit, a reaction unit, and a combination thereof.

10 30. The method of claim 24 further comprising contacting the methyl-t-butylether with phosphoric acid.

15 31. The method of claim 24 wherein separating the acid product comprises concentrating the acid product such that the molar ratio ROH:BF₃ in the acid product is from about 2:1 to about 4:1.

32. The method of claim 31 wherein the concentrated acid product comprises a molar ratio of ROH:BF₃ from about 2:1 to about 3:1.

20 33. The method of claim 24 wherein the acid composition comprises a molar ratio of ROH:BF₃ from about 1.6:1 to about 3: 1.

34. The method of claim 33 wherein the acid composition comprises a molar ratio of ROH:BF₃ from about 1.9:1 to about 3: 1.

25 35. The method of claim 24 wherein the product composition contains nonanoic methyl esters such that the molar ratio of methyl pivalate to nonanoic methyl esters is about 4 or greater.